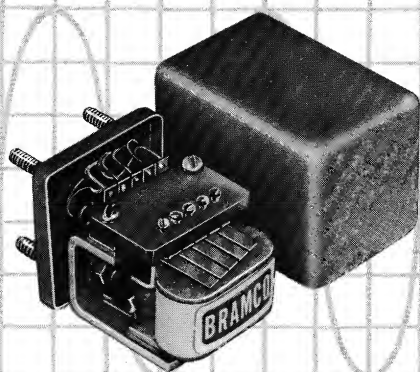




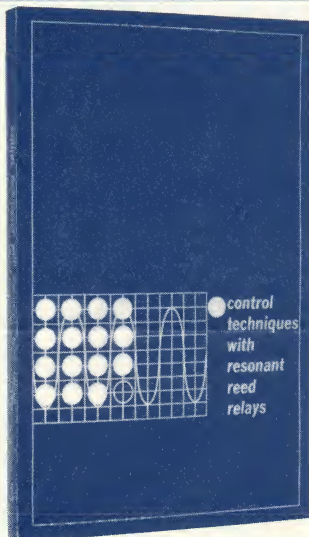
Remote Controls

ENCODER / DECODER
COMPONENTS & SYSTEMS
TO COMMAND,
SELECT, INDICATE,
AND REGULATE



BRAMCO CONTROLS DIVISION, LEDEX INC.
College and South Streets, Piqua, Ohio 45356 • Phone 513-773-8271

control techniques with resonant reed relays



64 pages

... discusses fundamental resonant reed theories, definitions, basic applications. 40 schematics, 10 block diagrams. If you work with controls that select, command, regulate, supervise, or indicate, you should know about how it can be done with audio signals. This book shows you how.

contents

	Page
SECTION I. INTRODUCTION TO RESONANT REEDS	
How reed decoders work	4
How reed encoders work	7
Resonant reeds compared to LC circuits	8
Definitions of response characteristics	9
Interrelated performance characteristics	14
Test procedure and equipment	16
Application tips	19
SECTION II. SCHEMATIC DIAGRAMS	
Resonant reed stabilized oscillator circuit	26
Germanium oscillator with high impedance output	27
Silicon oscillator with high impedance output	27
Oscillator circuit with 600 ohm output	28
Tube type resonant reed oscillator	29
Multi-reed capacitance encoder circuit	30
Single tone pulsed encoder	31
Two-tone sequential pulsed encoder	32
LC oscillator circuit, transistor type	34
LC oscillator circuit, tube type	34
Transistor decoder circuit	35
Five channel decoder circuit	36
Push-pull audio amplifier	37
Tube type amplifier circuit	38
Secondary relay switch circuit	39
Latching switch circuit	40
Timed latching switch circuit	41
Stepping switch circuit	42
Tube type decoder switch circuit	43
Neon lamp indicator	44
Incandescent light switch	44
Two-tone sequential switch circuit	45
Two-tone simultaneous switch circuit	45
Two-tone sequential decoder	46
Ten-tone selective stepping switch	47
Five-tone selective ten-position stepping switch	48
28-function relay tree	49

Please send **CONTROL TECHNIQUES** to

name _____

title _____ dept. _____

company _____

address _____

city _____ state _____ zip code _____

BRAMCO CONTROLS DIVISION, LEDEX INC.
College and South Streets Piqua, Ohio

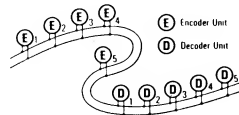
Design your own remote control systems with audio signal modules

Start with encoder. It is a solid state oscillator with a resonant reed which generates an audio tone to control a single function. You transmit over wire or radio.



Single Channel Encoder

A single pair of wires, or a leased telephone line, can carry the audio signals for a complete control system.



For inaccessible areas or mobile installations, a radio transmitter and receiver system can carry the signals.

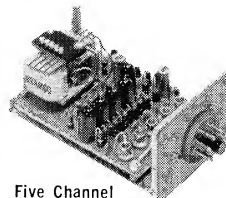


Companion decoder has a solid state amplifier, resonant reed relay and transistor switch. It responds to frequency signal, translates it into control function. Because of the narrow and accurate bandwidth of the decoder, your system can have more than 30 different frequencies in the 300 to 1600 cps range. With single channel modules you can easily add channels or change frequencies.



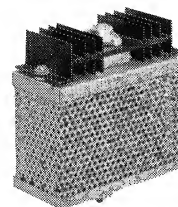
Single Channel Decoder

Five channel decoder modules are also available, perform five functions in less space and at lower cost per function.



Five Channel Decoder

Solid state power supply, regulated and filtered for audio tone systems, can handle more than 30 encoder modules, or 10 single channel decoder modules or two 5-channel decoder modules, plus secondary loads.



Power Supply Module

The narrow bandwidth (1%) of Bramco resonant reeds makes them ideal for simultaneous and sequential coded tone systems. The number of control functions is virtually unlimited. For example, you can control over 4800 individual functions with only 20 frequencies coded simultaneously in groups of four.

If you work with controls that command, select, regulate, or indicate, you should know about resonant reed systems. The Bramco module way is simple, flexible, economical and dependable.

We stock standard resonant reeds and modules, and design specials. Write for literature or call 513-773-8271.



BRAMCO CONTROLS DIVISION, LEDEX INC.
College and South Streets, Piqua, Ohio 45356



BRAMCO CONTROLS DIVISION, LEDEX INC.
College and South Streets, Piqua, Ohio 45356 • Phone 513-773-8271

RESONANT REED DEFINITIONS

DATA SHEET 18

Resonant Frequency is the frequency of audio input at which contact closure can be obtained with the least amount of power input.

Natural Frequency is that frequency at which an encoder reed operates.

Design Frequency is the reference frequency from which tuning tolerance and bandwidth are specified.

Frequency Tuning Tolerance is the allowable range within which the resonant (or natural) frequency is tuned.

Frequency Stability is the frequency variation per degree centigrade of temperature change. The change varies inversely to temperature with 25° C. reference.

Bandwidth is the frequency range through which closure occurs at normal operating power level.

Minimum Bandwidth is the frequency range through which contact closure must occur. It is specified at the normal operating power level and referenced to design frequency.

Maximum Bandwidth is the frequency range outside of which contact closure must not occur. It is specified at the normal operate power level and referenced to design frequency.

Threshold Sensitivity is the minimum power level at which contact closure occurs.

Minimum Sensitivity is the power level above which contact closure must occur at design frequency input.

Maximum Sensitivity is the power level below which contact closure must not occur at any frequency input.

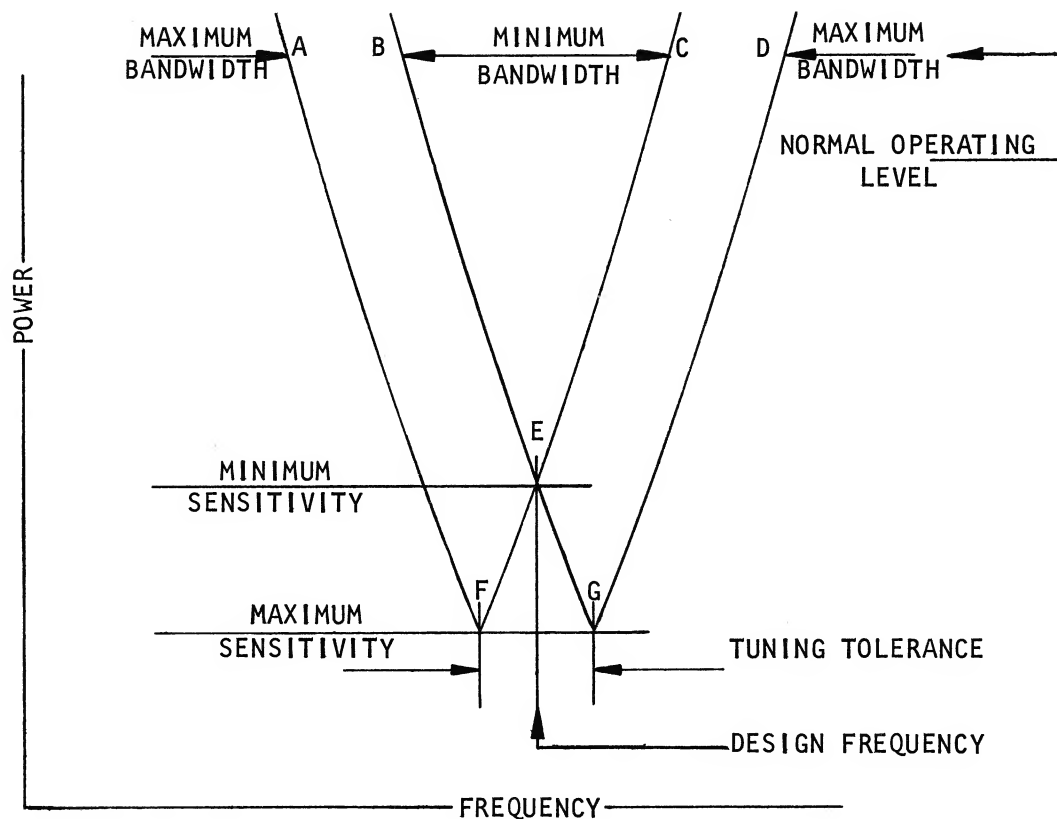
Contact Duty Cycle is the percentage of time the contacts are closed per cycle. It is measured at resonant frequency and normal operating power level.

Contact Rating is the maximum peak voltage and current into a resistive load.

Response Time is the elapsed time between application of the signal to the relay coil and the initial contact closure. It is measured at resonant frequency and normal operating power level.

MORE ►

Diagram of two relay response curves at extremes of the tuning tolerance, illustrating the derivation of sensitivity and bandwidth specifications.



Area ACF represents response* of a relay tuned to the extreme low limit of tuning tolerance.

Area BDG represents response of a relay tuned to the extreme high limit of tuning tolerance.

Area BCE represents the assured system response, with any relay tuned within the tuning and bandwidth tolerances.

Area ADFG represents the region within which response may occur, but outside of which response is assured not to occur.

*Response is defined as contact closure obtained by slowly increasing power at fixed frequency settings.



STANDARD FREQUENCY CHART

DATA SHEET 19

The frequencies listed below have been established to allow adequate separation and minimum harmonic relationship for use in multiple frequency systems.

FREQ. C.P.S.	EIA CODE	FREQ. C.P.S.	EIA CODE	FREQ. C.P.S.	EIA CODE	FREQ. C.P.S.	EIA CODE
67.0	L 1	192.8	7A	410.8	114	810.2	157
71.9	L 2	203.5	M1	422.1	145	832.5	127
77.0	L 3	210.7	M2	433.7	115	855.2	158
82.5	L 4	218.1	M3	445.7	146	879.0	128
88.5	L 4A	225.7	M4	457.9	116	903.0	159
94.8	L 5	233.6	M5	470.5	147	928.1	129
100.0	1	241.8	M6	483.5	117	953.7	160
103.5	1A	250.3	M7	496.8	148	979.9	130
107.2	1B	258.8	136	510.5	118	1006.9	161
110.9	2	266.0	106	524.6	149	1049.6	131
114.8	2A	273.3	137	539.0	119	1084.0	P
118.8	2B	280.8	107	553.9	150	1120.0	S11
123.0	3	288.5	138	569.1	120	1190.0	S12
127.3	3A	296.5	108	582.1	H	1220.0	S2
131.8	3B	304.7	139	600.9	121	1265.0	S14
136.5	4	313.0	109	617.4	152	1291.4	S3
141.3	4A	321.7	140	634.5	122	1320.0	S15
146.2	4B	330.5	110	651.9	153	1355.0	S16
151.4	5	339.6	141	669.9	123	1400.0	S17
156.7	5A	349.0	111	688.3	154	1430.5	S7
162.2	5B	358.6	142	707.3	124	1450.0	S18
167.9	6	368.5	112	726.8	155	1500.0	S20
173.8	6A	378.6	143	746.8	125	1520.0	S9
179.9	6B	389.0	113	767.4	156	1550.0	S21
186.2	7	399.8	144	788.5	126	1600.0	S22

MODEL	RECOMMENDED RANGE	TOTAL RANGE
RD 10, RE 10	67-300 (39)	67-1600 (100)
RD 1, RE 1	300-600 (25)	300-1600 (61)
RD 5	200-600 (38)	100-1000 (77)
RD 7	150-500 (40)	150-700 (52)

Figures in parentheses are the number of standard frequencies possible within the listed range.



SINGLE CHANNEL

Audio Tone Encoding

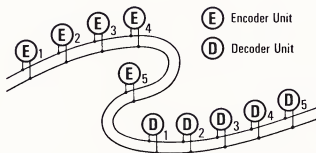
ENCODER COMPONENTS
AND SYSTEMS
TO COMMAND,
SELECT, INDICATE,
AND REGULATE



BRAMCO CONTROLS DIVISION, LEDEX INC., PIQUA, OHIO

audio tone encoding

An audio tone can be generated by an electronic oscillator or resonant reed encoder circuit, then transmitted by wire or radio. The tone activates a resonant reed relay to perform a control function that selects, indicates, or regulates.



A single pair of wires, or a leased telephone line, can carry the audio signals for a complete control system.



For inaccessible areas or mobile installations, a radio transmitter and receiver system can carry the signals.

Bramco* resonant reed encoders are precision electromechanical devices designed for use as the frequency determining components in audio oscillator circuits.

Accurately tuned and processed, the reed is free to vibrate as a single tine of a tuning fork. It is biased by an alnico permanent magnet. As it vibrates, the reed motion induces an impedance change in the coil at the tuned frequency. This impedance change regulates the frequency of the oscillator circuit.

Bramco encoder reeds are engineered for high accuracy. This feature, combined with the narrow response bandwidth of Bramco decoder reeds, permits over 50 selective control frequencies within the 67 to 1600 cps spectrum.

A big advantage of reeds in control switching is that they are ideally suited for simultaneous and sequential coded tone systems. The actual number of control functions possible in such a system is virtually unlimited. For example, over 3300 individual control functions are possible with only 16 frequencies coded sequentially in groups of three.

Bramco resonant reed encoders, compared to other types of audio tone oscillators, offer these main benefits: frequency accuracy, temperature and voltage stability, and simplified frequency changing in the field.

RE1: The RE1, with a broad frequency spectrum of 300 to 1600 cps, is a universal single channel encoder for any remote control system that must deliver reliable performance under tough operating conditions. A floating type internal shock mount assures high stability under mobile conditions—makes it ideal for two way selective call systems in mobile communications and industrial supervisory controls.

RE10: Comparable to the RE1 in construction and performance, the RE10 extends the frequency spectrum to the lower 67 to 300 cps range. If you're concerned about command signals interfering with normal voice communications, a sub-audible selective call system designed around the RE10's low frequency spectrum provides an ideal solution.

ME1C: Plug it in. Add power. This compact encoder module is ready to go to work as delivered. One (or several) ME1C modules comprise the entire encoding portion of your control system.

The transistorized ME1C plug-in encoder is a complete oscillator circuit with a built-in resonant reed stabilizer. Requiring only a DC voltage input, it provides a continuous running fixed audio sine wave output. The output is keyed to give immediate response when a signal is desired.

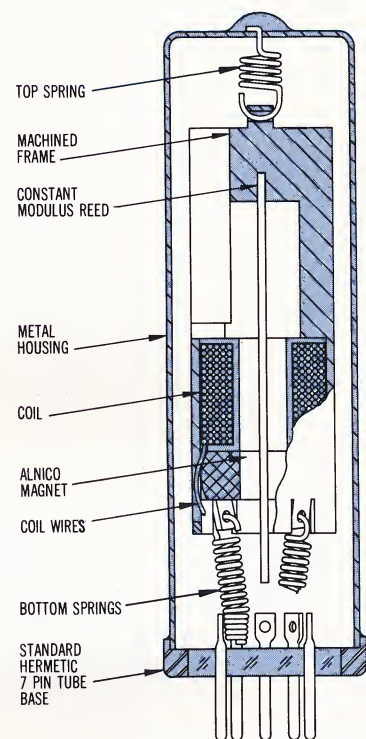
The single channel modular concept offers flexibility, allowing the addition of as many frequencies as required for a particular system. Each module, when individually keyed, provides one control function. For multiple control functions, more than 50 separate frequencies within the 67 to 1600 cps range can be provided for use in one system.

The all-transistorized circuitry is mounted on a rugged glass-epoxy printed circuit board. An internal adjustment control allows the output level to be set from 0 to maximum. The frequency of each module can be conveniently changed by replacing the plug-in resonant reed stabilizer.

A complete high stability oscillator network, the ME1C serves as an economical and dependable encoder for any of Bramco's resonant reed decoder products.

Companion decoder modules and plug-in power supplies are also available.

RE1





standard specifications

RE1 resonant reed oscillator stabilizer

frequency range	300 to 1600 cps
frequency tolerance	$\pm .1\%$ *
frequency stability	varies less than .002% per °C (25°C REF.)
temperature range	-40°C to +85°C
coil resistance	600 ohms dc $\pm 10\%$
output impedance	depends on circuit used
output	sine wave: amplitude and frequency de
harmonic distortion	depends on circuit used
power required	

*STANDARD ENCODERS are tuned to provide the s

AUDIO TONE CONTROL SYSTEM USING RE1 OR RE10 ENCODERS

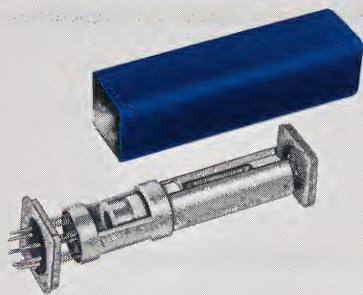
E = encoders, 5 frequencies

T = transmission line: RF carrier
or 2 wire loop

D = decoders, 5 frequencies

F = controlled functions

NOTE: Function 4 illustrates the
use of two simultaneous or se-
quential tones to code a single
function.



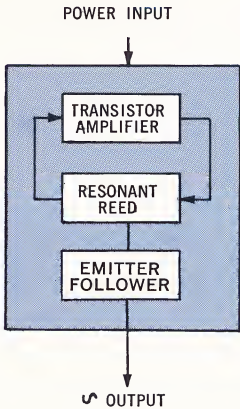
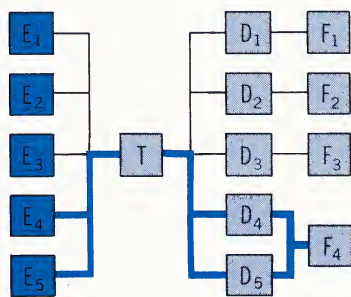
RE10
resonant reed oscillator stabilizer

ME1C
resonant reed encoder module

67 to 300 cps	67 to 1600 cps
$\pm .1\%$ or $\pm .1$ cps (whichever is greater)*	$\pm .15\%$
varies less than .002% per °C (25°C REF.)	varies less than .002% per °C (25°C REF.)
-40°C to +85°C	-40°C to +85°C
600 ohms dc $\pm 10\%$	
depends on circuit used	600 ohms
pending on circuit used	Sine wave adjustable to 2 VRMS into 600 ohms minimum
depends on circuit used	less than 5%
.....	18 ma at 12 or 24 vdc

pecified frequency in the encoder circuits shown (Fig. D).

ME1C FUNCTIONAL BLOCK DIAGRAM



dimensional data

base diagrams

FIG. A

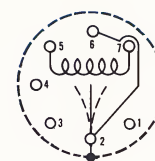
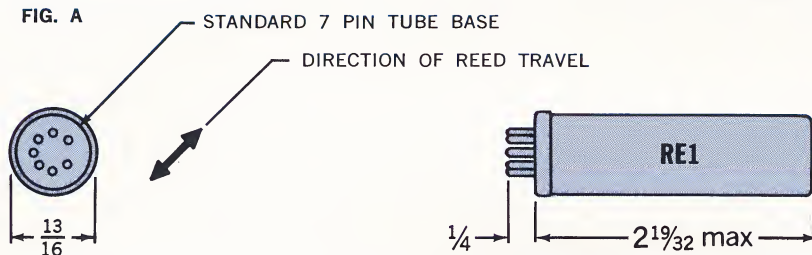


FIG. B

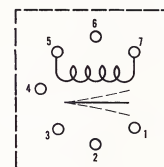
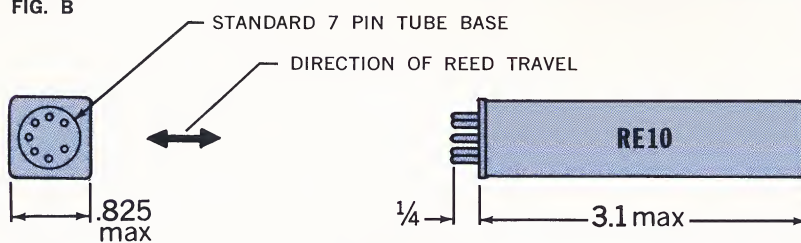
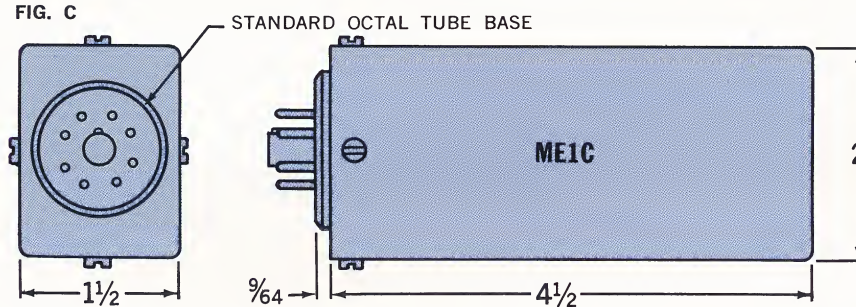
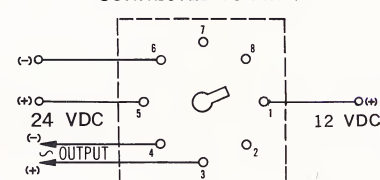


FIG. C



PIN 6 INTERNALLY CONNECTED TO PIN 4



ME1C has built-in circuit for 12 or 24 volt operation. Pin 6 is DC power negative. Use Pin 1 for +12 VDC, Pin 5 for +24 VDC.

recommended encoder circuitry

Standard RE1 and RE10 encoders are tuned to provide the specified frequency in the encoder circuit (Figure D). The feedback adjustment in the oscillator circuit is provided to set the circuit gain slightly above the oscillator threshold. While not a critical adjustment, excessive feedback will result in output distortion.

Buildup time will vary from .1 to 60 seconds, depending upon frequency and feedback setting. This delay time should be considered when designing your system. The circuit will not free-run when the reed unit is disconnected.

It is recommended that the oscillator run continuously and be keyed to the amplifier to give immediate response when a signal is desired.

FIG. D. RECOMMENDED ENCODER CIRCUIT

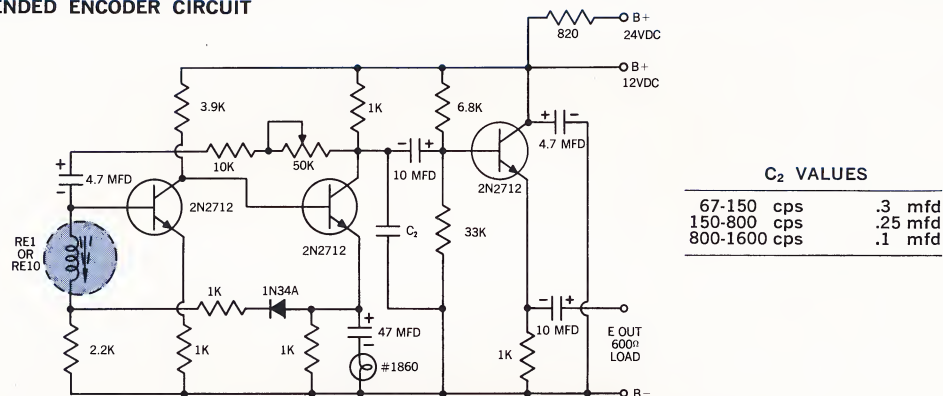
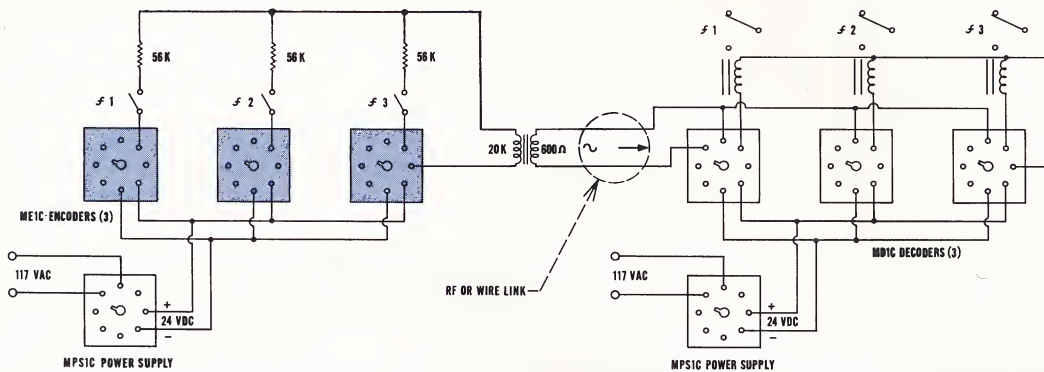


FIG. E. TYPICAL ENCODER-DECODER MODULE WIRING DIAGRAM



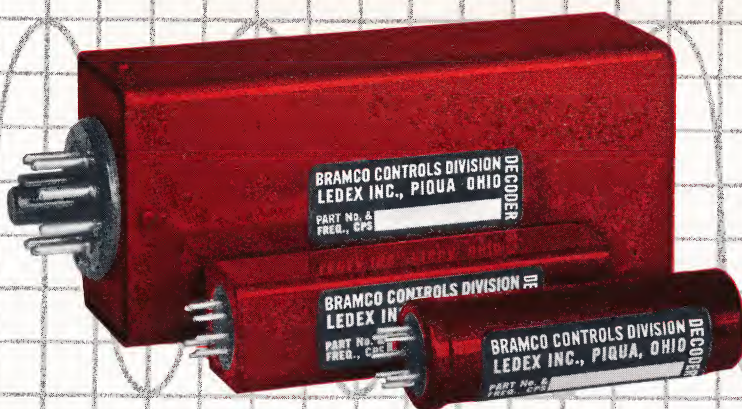
specializing in remote controls...

Bramco engineers specialize in remote controls through single and multi-channel frequency sensing encoder/decoder components and modular systems. We welcome the opportunity to share our specialized skills with you. For application assistance, contact the factory or your nearest representative: ►



BRAMCO CONTROLS DIVISION, LEDEX INC.

College and South Streets, Piqua, Ohio 45356 • Phone 513-773-8271



SINGLE CHANNEL

Audio Tone Decoding

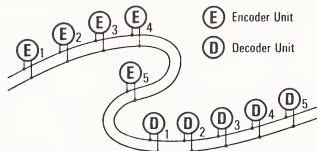
**DECODER COMPONENTS
AND SYSTEMS
TO CONTROL,
SELECT, INDICATE,
AND REGULATE**



BRAMCO CONTROLS DIVISION, LEDEX INC., PIQUA, OHIO

audio tone decoding

An audio tone can be generated by an electronic oscillator or resonant reed encoder circuit, then transmitted by wire or radio. The tone activates a resonant reed relay to perform a control function that selects, indicates, or regulates.



A single pair of wires, or a leased telephone line, can carry the audio signals for a complete control system.



For inaccessible areas or mobile installations, a radio transmitter and receiver system can carry the signals.

Bramco* resonant reed decoders are precision electromechanical devices that are used as frequency selective filters.

Heart of the decoder is an accurately tuned and processed reed which vibrates as a single tine of a tuning fork. The reed, which is biased by a permanent magnet, has normally open relay contacts. When a predetermined AC signal is introduced, the magnetic field fluctuates, causing the reed to vibrate and the contacts to close intermittently. This provides a switching function. If the load is higher than the reed contact rating, an auxiliary circuit can be used.

Bramco decoder reeds are engineered for narrow response bandwidth. This feature, combined with the high accuracy of Bramco encoder reeds, permits over 50 selective control frequencies within the 67 to 1600 cps spectrum.

A big advantage of reeds in control switching is that they are ideally suited for simultaneous and sequential coded tone systems. The actual number of control functions possible in such a system is virtually unlimited. For example, over 3300 individual control functions are possible with only 16 frequencies coded sequentially in groups of three.

Bramco resonant reed decoders, compared to other types of tone filters, are small and inexpensive. They give more control functions per spectrum, per size, per dollar—often pay for themselves by the wire they save.

RD1: The RD1, with a broad frequency spectrum of 300 to 1600 cps, is a universal single channel decoder for any remote control system that must deliver reliable performance under tough operating conditions. A floating type internal shock mount assures high stability under mobile conditions—makes it ideal for two way selective call systems in mobile communications and industrial supervisory controls.

RD10: Comparable to the RD1 in construction and performance, the RD10 extends the frequency spectrum to the lower 67 to 300 cps range. If you're concerned about command signals interfering with normal voice communications, a sub-audible selective call system designed around the RD10's low frequency spectrum provides an ideal solution.

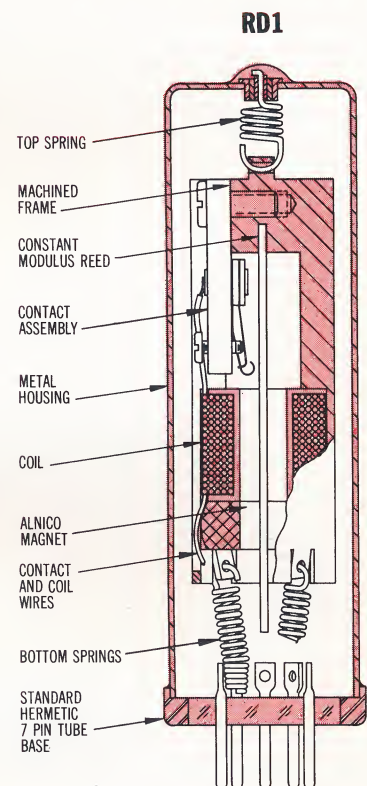
MD1C: To decode, plug it in. Add power. This compact module is ready to perform your complete decoding function. It contains an all-transistorized single stage amplifier, a high stability resonant reed relay, and a secondary transistor switching circuit.

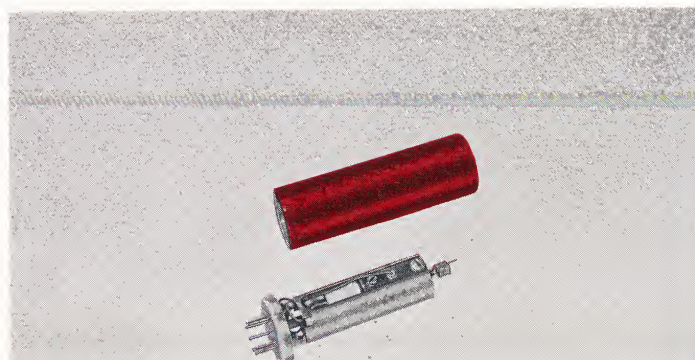
The decoder module is a narrow band audio frequency detector. Its response characteristics are controlled by a frequency sensitive resonant reed relay. When an audio signal of the proper frequency is introduced, the reed resonates at its tuned frequency causing an intermittent contact closure once each cycle. The contact closure triggers the transistor switching circuit which provides a continuous output control function.

The single channel modular concept offers flexibility, allowing the addition of as many frequencies as required for a particular system.

The complete circuitry is mounted on a rugged glass epoxy printed circuit board. The frequency determining resonant reed relay is a plug-in component—making it easy to change the frequency of the module if desired.

Special relays can be supplied to provide varied response characteristics to customer requirements. Companion encoder modules and plug-in power supplies are also available.





RD1
frequency sensing resonant reed relay

standard specifications

frequency range	300 to 1600 cps
frequency stability	varies less than .002% per °C (25°C REF.)
temperature range	-40°C to +85°C
bandwidth	±.25% minimum, ±1.5% maximum*
operating voltage level	6 VRMS
coil resistance	600 ohms dc ±10%
input impedance	
sensitivity	.75 VRMS max., 2.0 VRMS min.*
contact duty cycle	10% min. at resonant freq., 6 VRMS
contact rating	100 ma peak at 12 vdc resistive load
power required	

*SPECIAL RELAYS can be supplied with varying bandwidths and ser

**AUDIO TONE CONTROL SYSTEM
USING RD1 OR RD10 DECODERS**

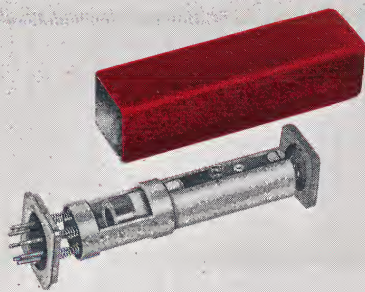
E = encoders, 5 frequencies

T = transmission line: RF carrier
or 2 wire loop

D = decoders, 5 frequencies

F = controlled functions

NOTE: Function 4 illustrates the
use of two simultaneous or se-
quential tones to code a single
function.



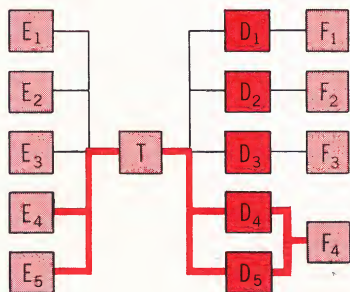
RD10
frequency sensing resonant reed relay



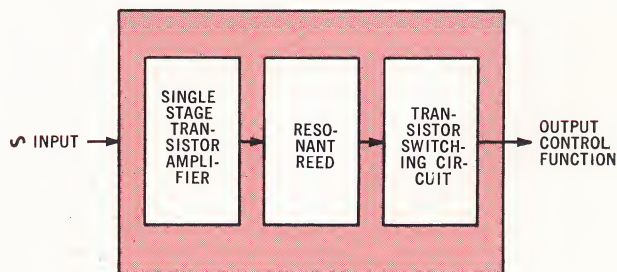
MD1C
resonant reed decoder module

67 to 300 cps	67 to 1600 cps
varies less than .002% per °C (25°C REF.)	varies less than .002% per °C (25°C REF.)
-40°C to +85°C	-40°C to +85°C
±1.0% minimum, ±2.0% maximum*	±.25% minimum at 1.5 VRMS ±2.5% maximum at 5 VRMS
3 VRMS	1.5 to 2 VRMS for linear bandwidth response 2 to 5 VRMS for constant bandwidth response
600 ohms dc ±10%	
.....	0.2 megohms minimum
.75 VRMS max., 1.5 VRMS min.*	0.1 VRMS maximum
10% min. at resonant freq., 3 VRMS	external load: 500 ohms minimum
100 ma peak at 12 vdc resistive load	50 ma maximum at 24 vdc
.....	30 ma at 24 vdc + external load

activities to meet customer requirements.

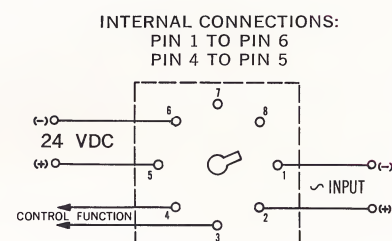
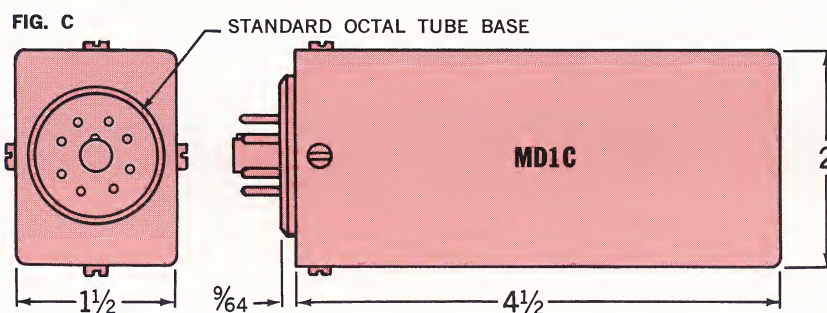
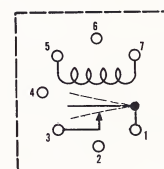
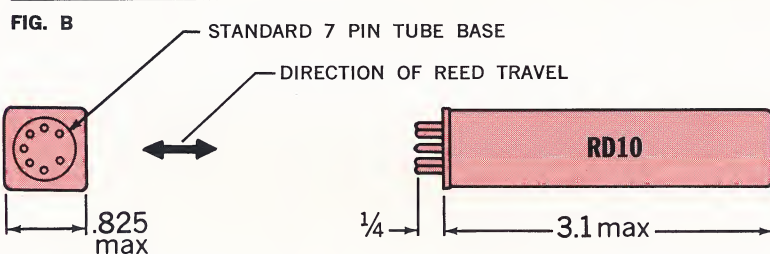
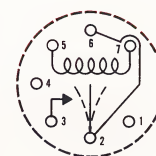
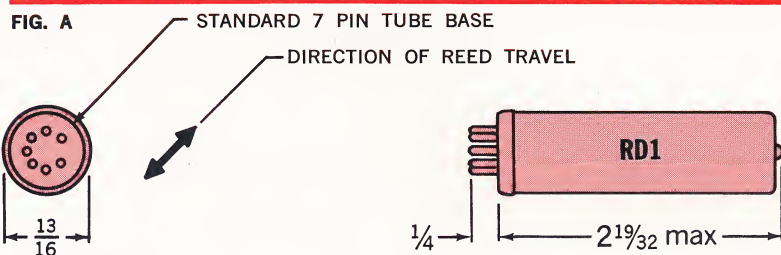


MD1C FUNCTIONAL BLOCK DIAGRAM



dimensional data

base diagrams



recommended decoder circuitry

The contacts of a resonant reed relay provide an intermittent closure, once each cycle. Continuous closure and heavier switching capacity is obtained by integrating a secondary relay, directly, or through a tube or transistor amplifier. Typical circuits for each method are illustrated in figures D, E, and F.

FIG. D. SECONDARY RELAY

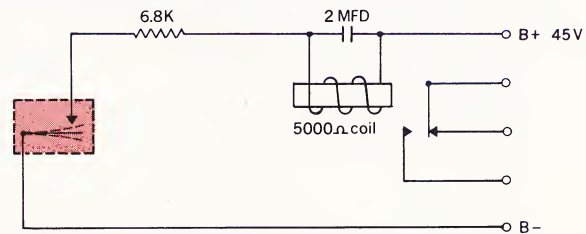


FIG. E. TUBE 6C4

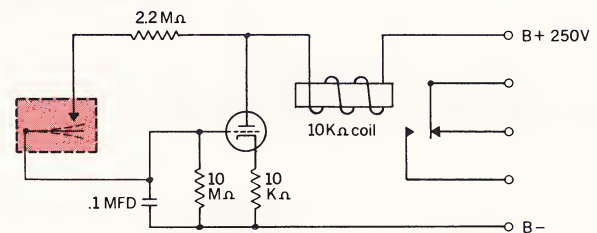


FIG. G. 2-TONE SIMULTANEOUS DECODER CIRCUIT

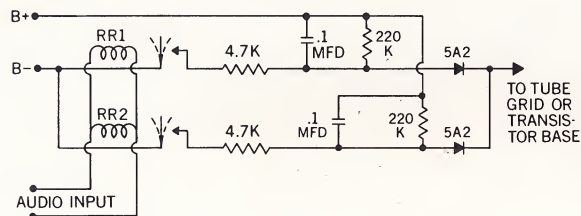


FIG. F. TRANSISTOR AMPLIFIER

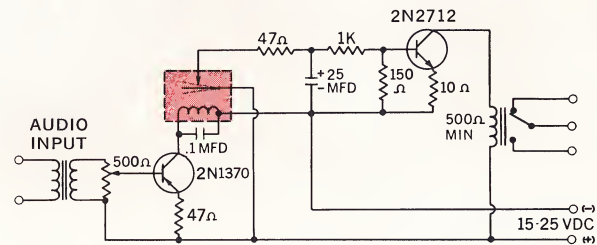
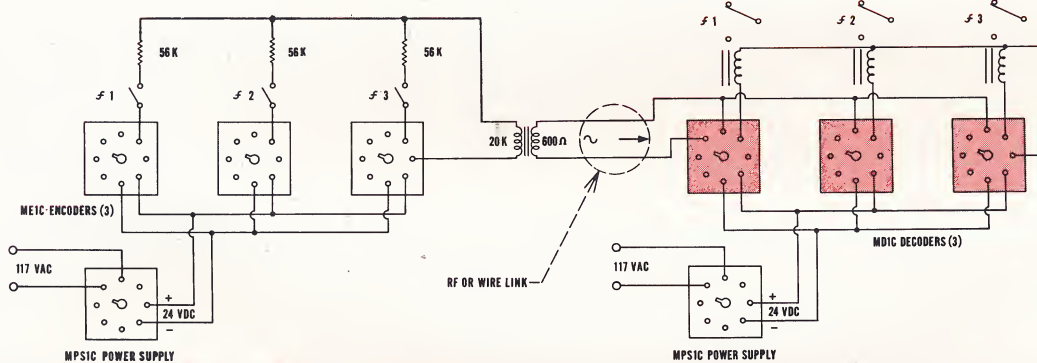


FIG. H. TYPICAL ENCODER-DECODER MODULE WIRING DIAGRAM



specializing in remote controls...

Bramco engineers specialize in remote controls through single and multi-channel frequency sensing encoder/decoder components and modular systems. We welcome the opportunity to share our specialized skills with you. For application assistance, contact the factory or your nearest representative: ►



BRAMCO CONTROLS DIVISION, LEDEX INC.

College and South Streets, Piqua, Ohio 45356 • Phone 513-773-8271



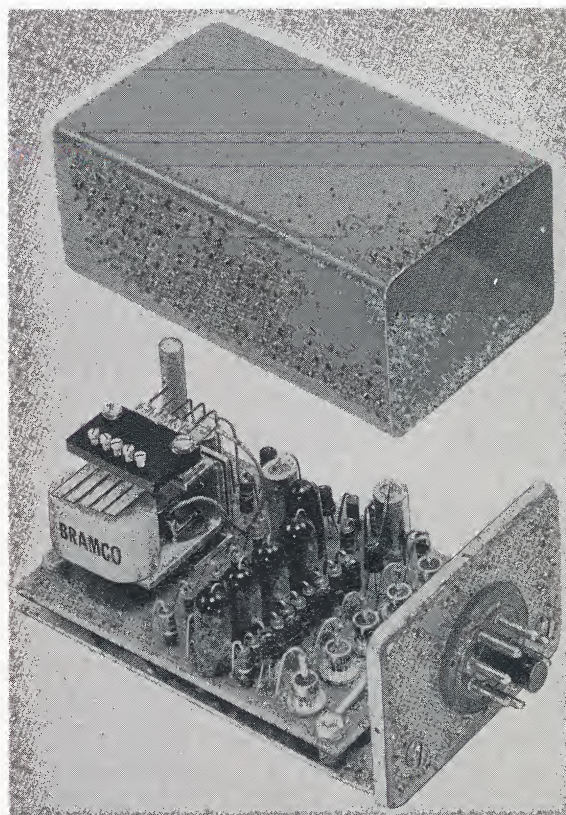
MD5C FIVE CHANNEL DECODER MODULE

DATA SHEET NO. 20

Plug it in. Add power. This five channel resonant reed decoder is ready to perform five separate remote switching functions - in the least amount of space and the lowest possible cost per channel. It includes a transistorized two-stage amplifier, a five channel resonant reed relay and five secondary transistorized switching circuits.

The module is a multi-channel narrow band audio frequency detector with response characteristics controlled by five frequency sensitive resonant reeds. When an audio signal of proper frequency is introduced, one of the five selected reeds resonates at its tuned frequency, causing an intermittent contact closure once each cycle. The contact closure triggers the corresponding transistor switching circuit, which then provides a continuous output control function.

The individual outputs can control secondary relays which are wired into logic circuits to provide a control function only when a sequential or simultaneous tone code is received.

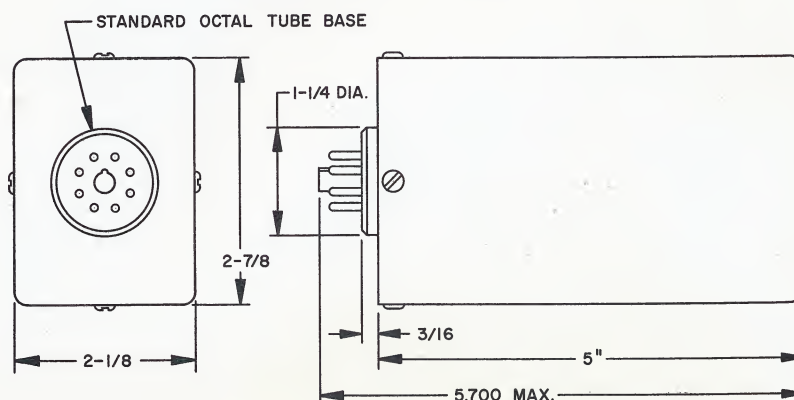
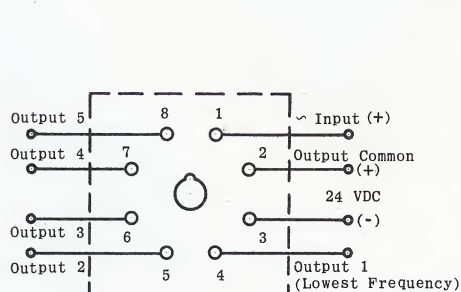


STANDARD SPECIFICATIONS

Number of Channels: 2, 3, 4 or 5
Frequency Range: 200 to 600 CPS
Frequency Stability: varies less than .002% per °C (25°C ref.)
Response Bandwidth: $\pm 2.5\%$ minimum at 1.5 VRMS
 $\pm 2.5\%$ maximum at 5.0 VRMS
Operating Voltage: 1.5 to 2 VRMS for linear bandwidth response
2 to 5 VRMS for constant bandwidth response

Input Impedance: 0.2 megohms minimum
Sensitivity: 0.1 VRMS maximum
External Load: 500 ohms minimum, each output
Output Rating*: 24 VDC at 50 ma maximum, each output, switching through external loads to B+
Power Required: 30 ma at 24 VDC, plus external loads

*Continuous output when signal within response bandwidth is applied to input.





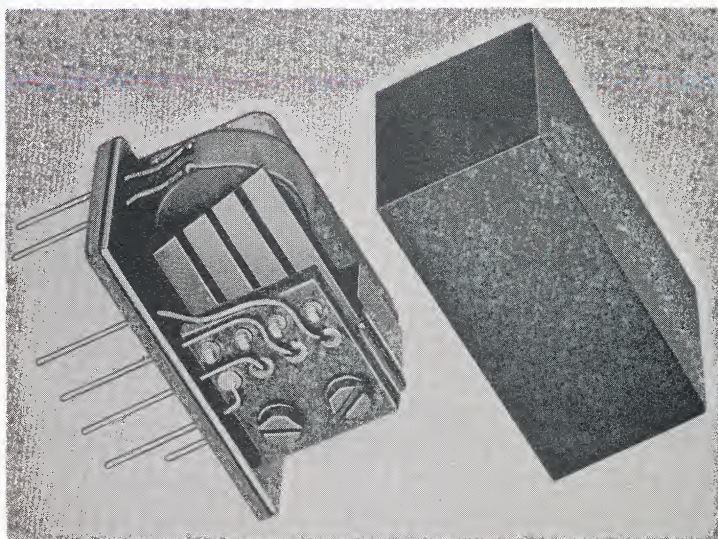
RD7C FOUR CHANNEL RESONANT REED RELAY

DATA SHEET NO. 21

The RD7C miniature resonant reed relay has four channels in a package volume of approximately 1/2 cubic inch - or 1/8 cubic inch per channel.

Signals to the small multi-channel resonant reed relay can be transmitted over a single wire loop or RF channel. Upon receiving the predetermined AC signal, the selected reed (or reeds) resonates. Any of the four channels can be closed independently. Contacts on the reeds then perform the switching functions. The reeds can be tuned to provide over 50 separate control frequencies within a spectrum of 150 to 700 cps.

The RD7C, besides being miniaturized, is designed to operate in narrow bandwidths ($\pm 1.5\%$ maximum). It is highly sensitive, requiring only 15 milliwatts normal drive level.



STANDARD SPECIFICATIONS

Number of Channels: 1, 2, 3 or 4

Frequency Range: 150 to 700 CPS

Standard: 313.0, 349.0, 389.0, 433.7

Frequency Stability: varies less than .0025%
per °C (25°C ref.)

Temp. Range: -40°C to +85°C

Response Bandwidth: $\pm 1.5\%$ minimum and
 $\pm 1.5\%$ maximum

Operating Voltage Level: 4 VRMS

Sensitivity: .5 VRMS maximum
1.5 VRMS minimum

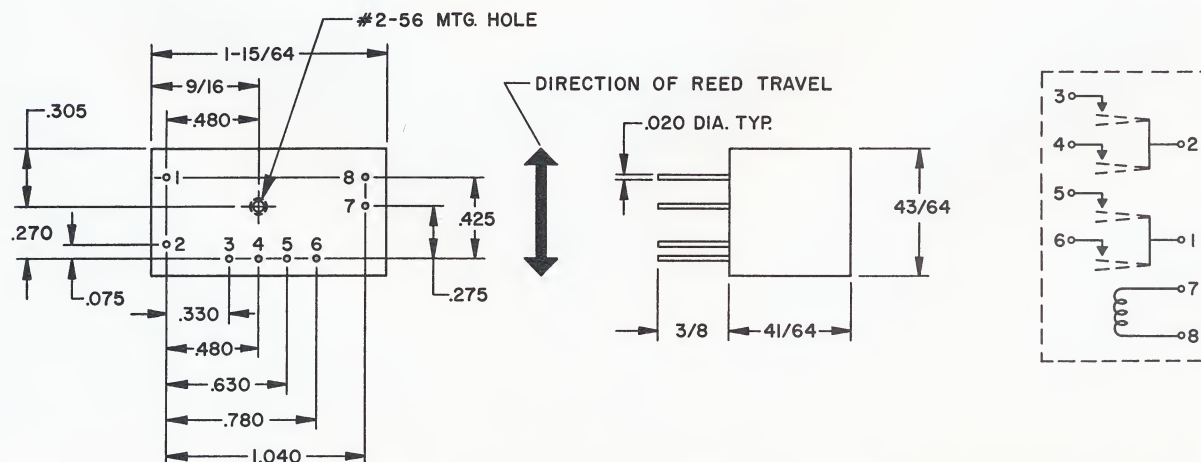
Coil Resistance: 1150 ohms DC $\pm 10\%$

Contact Duty Cycle: 10% minimum at resonant
frequency and 4 VRMS

Contact Rating: 10 ma peak at 12 VDC
resistive load

Mounting: Printed circuit board

Weight: 3/4 ounce



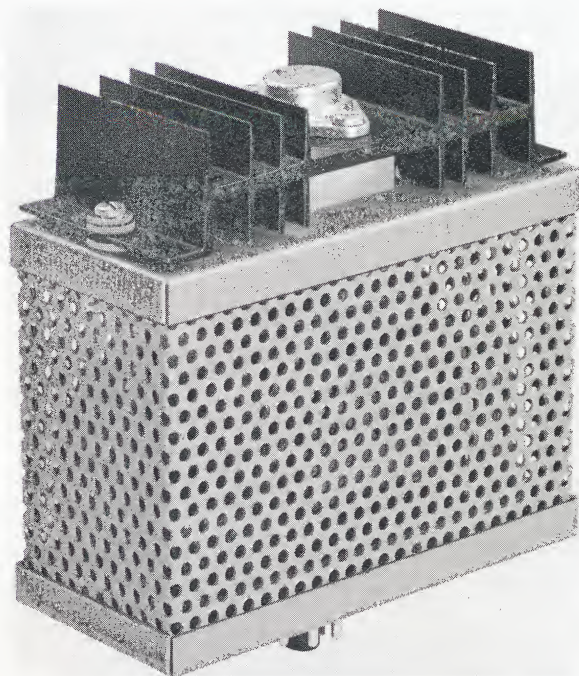


BRAMCO CONTROLS DIVISION, LEDEX INC.
College and South Streets, Piqua, Ohio 45356 • Phone 513-773-8271

MPS1C POWER SUPPLY

DATA SHEET NO. 22

The Bramco MPS1C is a transistorized ripple filtered and regulated power supply designed for use with audio tone control systems - or for any application requiring well-filtered DC power, in a small package and at low cost. Its plug-in design makes it a perfect companion to other Bramco encoder and decoder modules. Rated at 800 ma, the MPS1C can handle up to forty ME1C encoder modules, ten MD1C decoder modules, or a minimum of two MD5C decoder modules—including secondary loads.



STANDARD SPECIFICATIONS

Input Voltage: 105 to 130 VRMS, 60 cycle

Output Voltage: 24 VDC $\pm 5\%$ (no load, 25°C)

Output Current: 0 to 800 ma

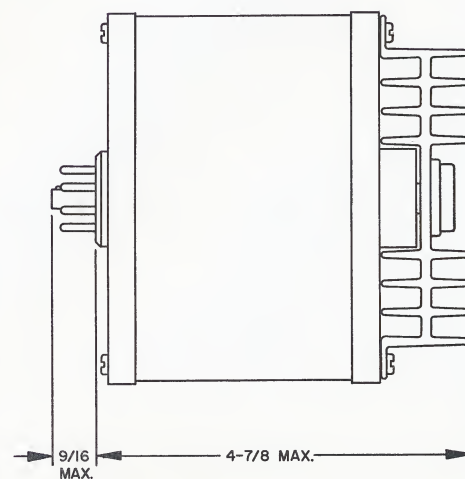
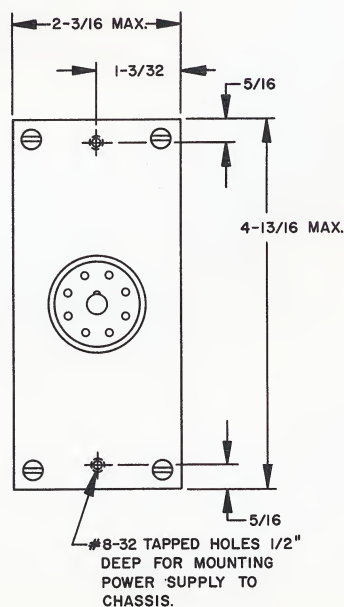
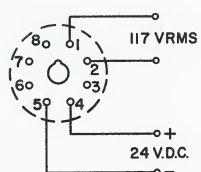
Output Ripple: .010 VRMS max. (Full load at 25°C)

Load Regulation: 2.0% (no load to full load at 25°C)

Line Regulation: 1.5% (105-130 VRMS input, full load)

Operating Temp. Range: -5°C to +50°C

Weight: 2 lbs., 5 oz.





RE2 TWIN TINE
OSCILLATOR STABILIZER
AND BANDPASS FILTER

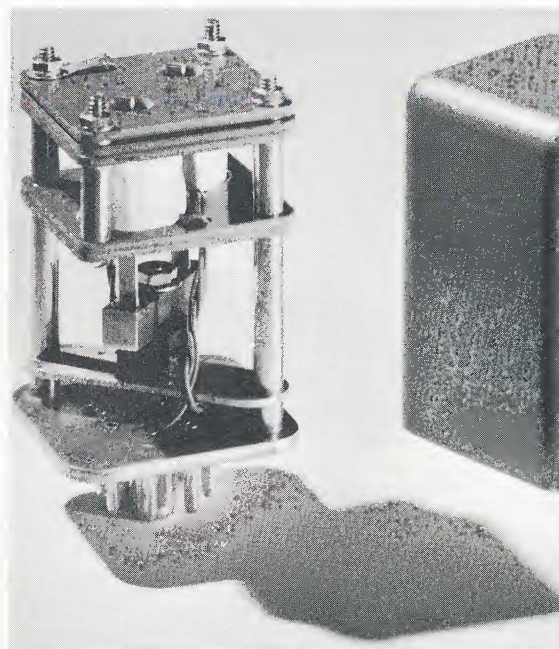
DATA SHEET NO. 23

Accurately tuned ($\pm 0.15\%$) and highly stable, the RE2 is an economical twin tine (tuning fork) oscillator stabilizer. It has twin resonant reeds coupled to separate coil and biasing magnet assemblies. In a low cost, non-critical oscillator circuit (fig. 1), one coil acts as a driver and the other as a pick-up — providing an accurate frequency determining element.

The RE2 can also be tuned to provide a high Q band-pass filter or decoder. Both tines vibrate when an input signal of the specified frequency is applied to the drive coil (fig. 2). Vibration of the second tine induces a signal in the pick-up coil. This signal can be rectified and applied to a DC amplifier to produce a DC output when the specified frequency is received.

As a decoder the bandwidth is in the order of .5% of design frequency. Frequencies outside the bandwidth are attenuated approximately 25 db. Coil and magnet assemblies are constructed to minimize coupling between the drive and pick-up coils, which is ideal for applications requiring electrical input-to-output isolation.

Inherent stability of the tuning fork configuration makes the RE2 resistant to shock and vibration, and insensitive to mounting variations. It is designed to operate indefinitely, on a continuous basis, as an encoder or decoder, and without degradation to output or frequency stability. It fits a standard octal tube socket and is hermetically sealed and shielded in a steel housing.



SPECIFICATIONS

Frequency Range: 67 to 300 CPS

Frequency Tolerance: $\pm 0.15\%$

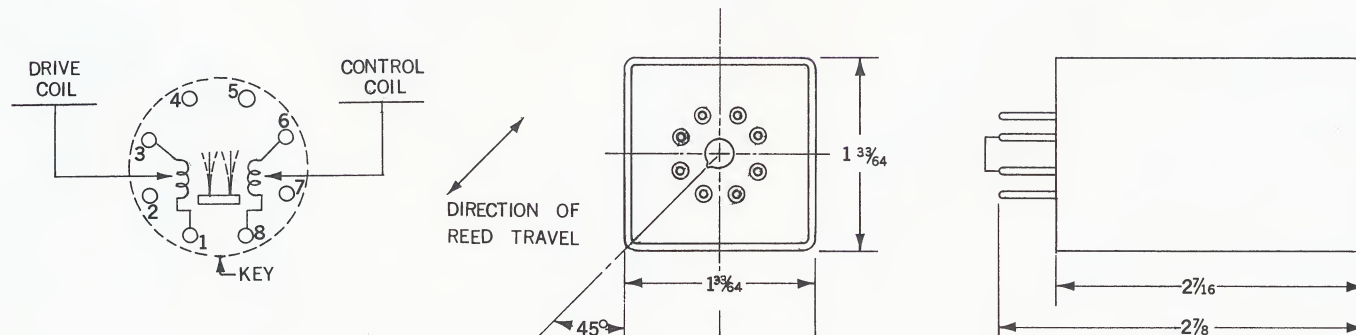
Frequency Stability: varies less than .002%
per $^{\circ}\text{C}$ (25°C ref.)

Temp. Range: -40°C to $+85^{\circ}\text{C}$

Coil Resistance: 2200 ohms $\pm 10\%$ (2)

Weight: 5 ounces

Other frequencies, coil resistances and decoder bandpass characteristics designed to meet specific application requirements.



MORE ►

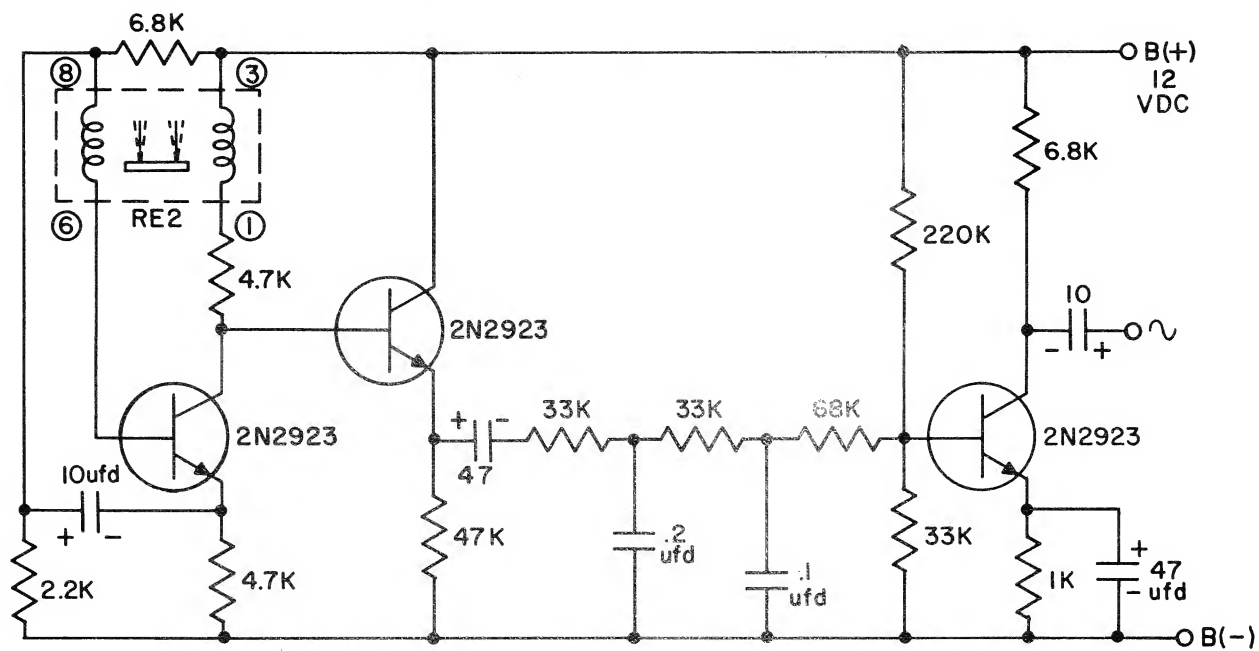


Fig. 1 RE2 ENCODER CIRCUIT

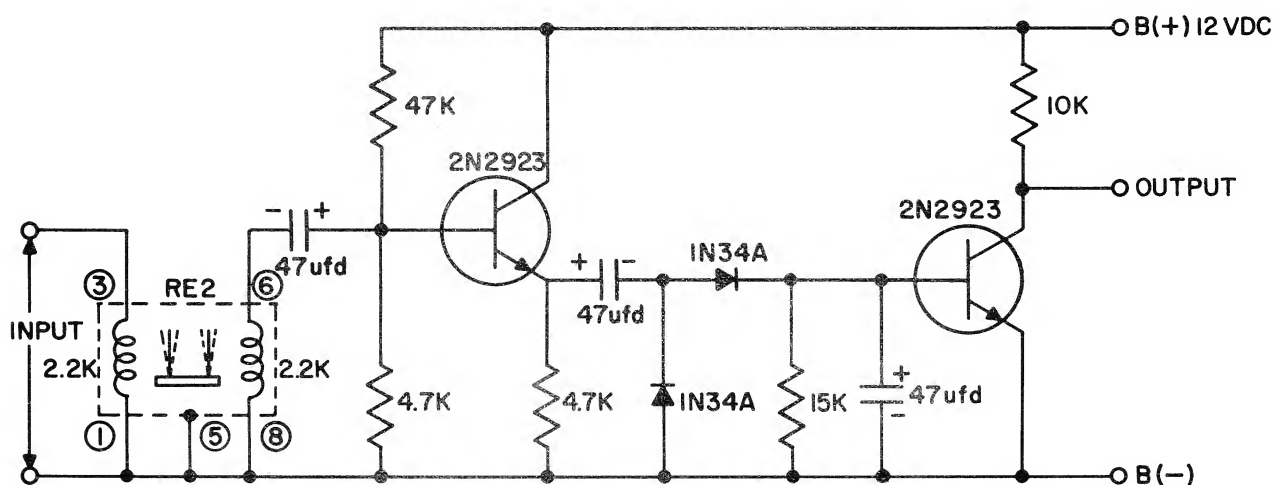


Fig. 2 RE2 DECODER CIRCUIT



BRAMCO CONTROLS DIVISION, LEDEX INC.
College and South Streets, Piqua, Ohio 45356 • Phone 513-773-8271

MA25C AMPLIFIER

DATA SHEET NO. 24

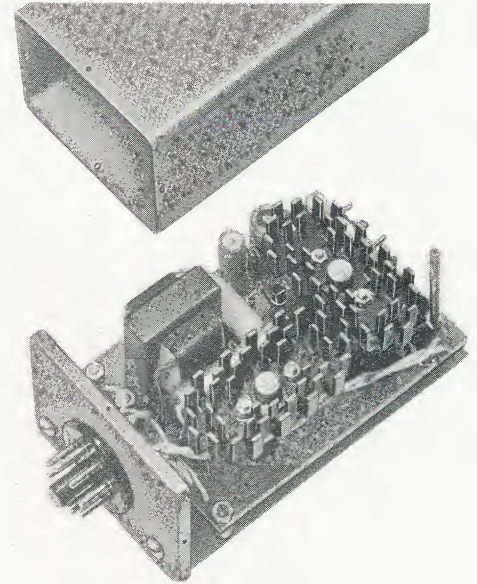
Solid state linear amplifier, model MA25C, is designed for multi-tone audio signaling systems. Its 2.5 watt rating is sufficient to drive 10 single channel resonant reed decoders (RD1 or MD2C) simultaneously.

Gain is adjustable from 0 to 47 db. Input impedance is 600 ohms, balanced and isolated for direct connection to standard telephone lines. Minimum output load impedance is 200 ohms. With an input of 0.022 VRMS per tone, minimum output is 5 VRMS per tone.

Power required is 24 VDC at a maximum of 350 ma. Operation is class B, so current drain is proportional to power output. Special Bramco amplifiers are available for systems with more than 10 simultaneous tones.

About simultaneous systems...

Any amplifier in a simultaneous tone system must be capable of handling the maximum number of tones that may be transmitted at a time. Bramco single channel decoder modules are available with or without built-in amplifiers. Modules with the built-in amplifiers (MD1C) are intended mainly for systems with single control functions at different remote locations, but these modules are also capable of working in systems with up to four simultaneous tones. For systems with 5 and up to 10 simultaneous tones MD2C decoder modules should be used. MD2C modules, which do not have built-in amplifiers, are used with the MA25C as a common amplifier.



SPECIFICATIONS

Frequency Range: 300 to 3000 CPS

Power Output: 2.5 watts
(22.5 VRMS into 200 ohms)

Load Impedance: Operates into a load resistance of 200 ohms or higher

Input Impedance: 600 ohms,
balanced and isolated

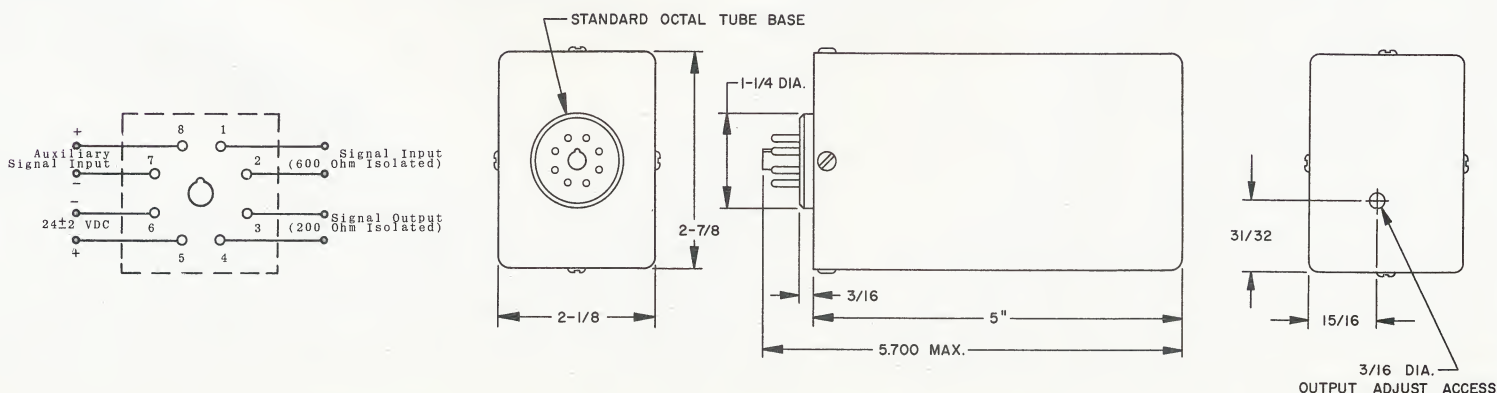
Input Signal Voltage: Full power output is reached with input voltage of .1 VRMS or less

Gain: Adjustable, 0 to 47 db

DC Input: 24 VDC at 10 to 350 ma

Temperature: 0 to 50°C

Distortion: Less than 3%
at 2.5 watts output



MORE

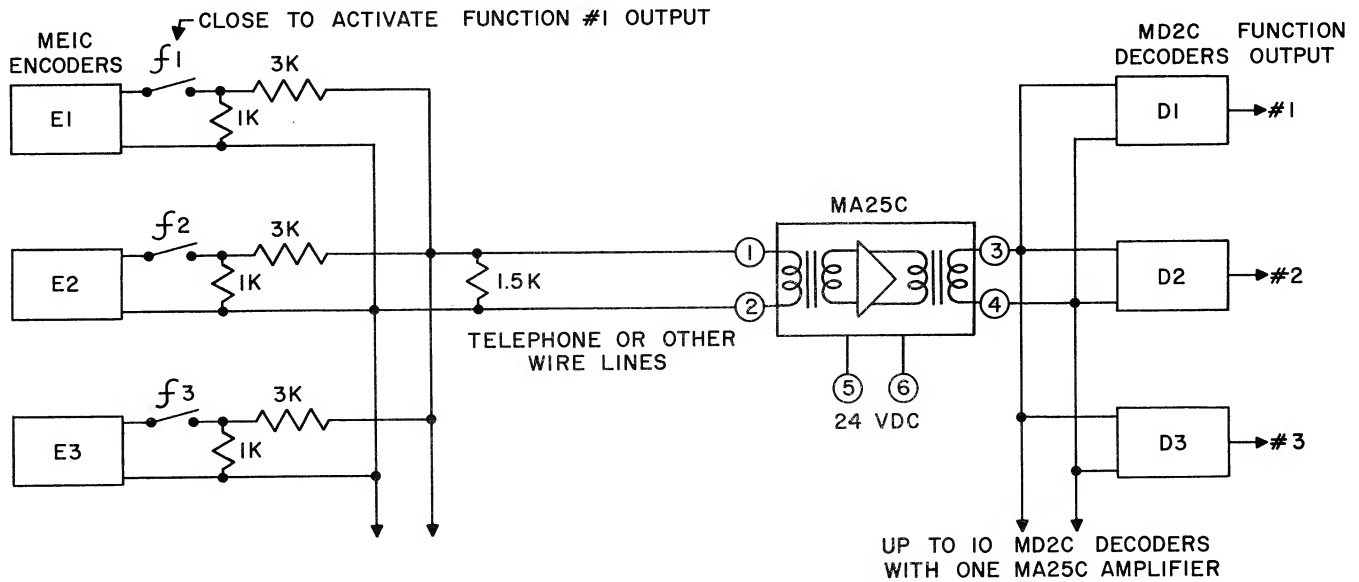


Figure 1

Because telephone lines are often restricted to a composite tone level of 0 DBM or less, the MA25C is normally applied at the receive (or decode) end. Locating the amplifier at the decode end, even in straight wire systems, makes it convenient to adjust the resonant reed drive level.

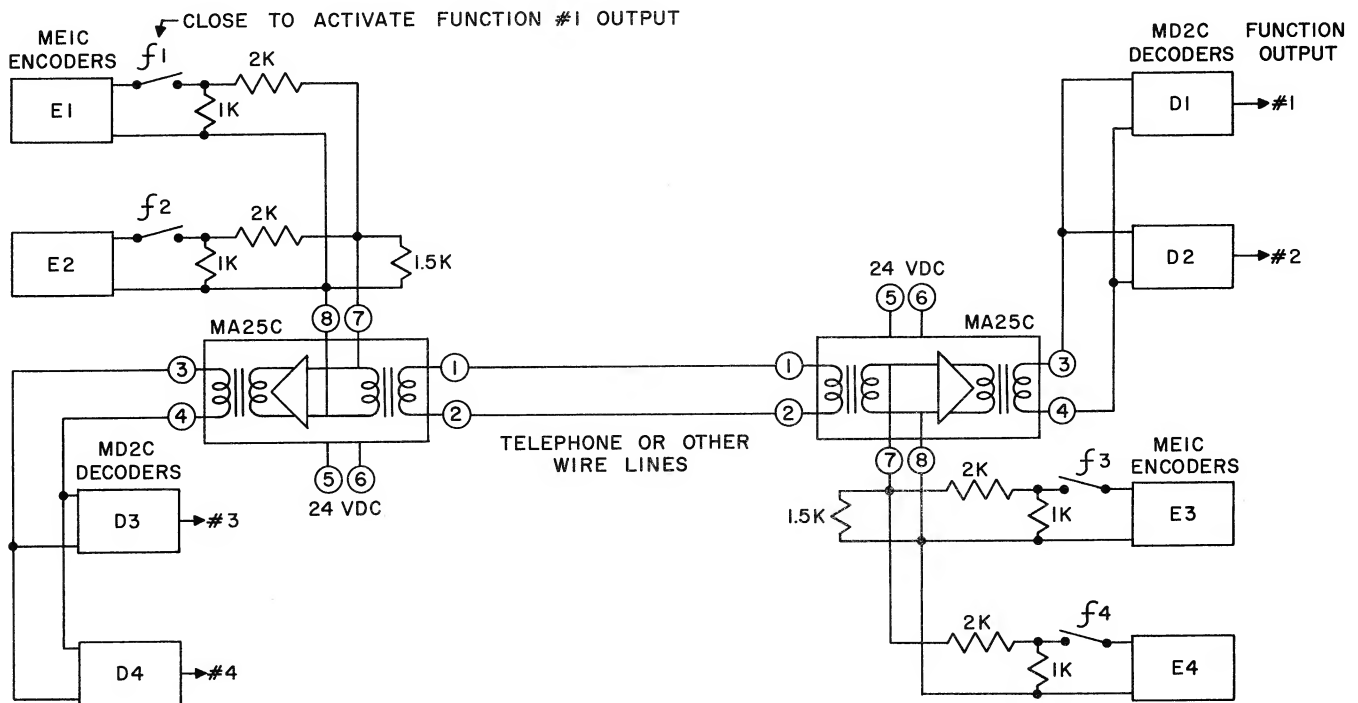


Figure 2

In two-way systems the line matching transformer of the MA25C can be used for the encoders. In this type of application the encoder outputs are connected to auxiliary input pins 7 and 8. An important consideration in this system is that the encoder per tone voltage level be no greater than 1.4 times the decode level when measured across pins 7 and 8.



BRAMCO CONTROLS DIVISION, LEDEX INC.

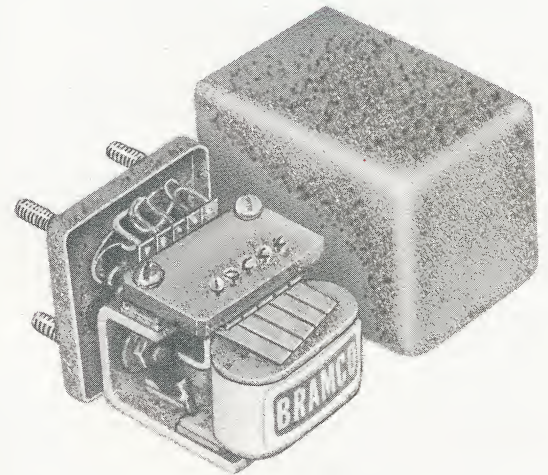
College and South Streets, Piqua, Ohio 45356 • Phone 513-773-8271

RD5 AND RD5S
RESONANT REED RELAYS

DATA SHEET NO. 25

The Bramco RD5 is a compact, low cost, multi-channel resonant reed relay. The RD5S, available with solder terminals or 9-pin plug-in base, is the same unit packaged in an hermetically sealed metal housing.

Models RD5 and RD5S have up to five frequency-selected switching circuits which can operate individually or simultaneously. When an audio tone of the proper frequency and amplitude is applied to the coil, the reed tuned to that frequency responds. Contacts of that reed then perform a switching function through an integrator circuit. The precisely tuned narrow bandwidth of each reed allows up to 38 frequencies to be used in the 200 to 600 CPS range.



SPECIFICATIONS

Number of Channels: 1, 2, 3, 4 or 5

Frequency Range: 200 to 600 CPS

Standard: 313.0, 349.0, 389.0,
433.7, 483.5

Frequency Stability: Varies less than
.002% per °C (25°C ref.)

Temperature Range: -40°C to +85°C

Response Bandwidth: $\pm 0.5\%$ minimum
 $\pm 2.0\%$ maximum

Operating Voltage Level: 6 VRMS

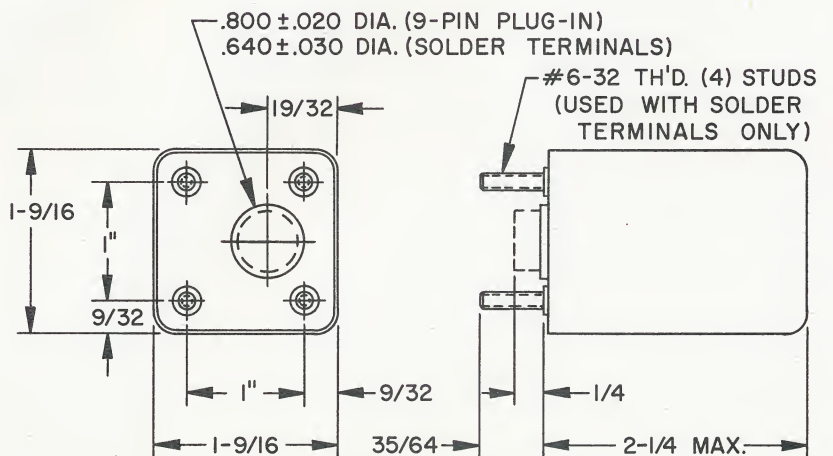
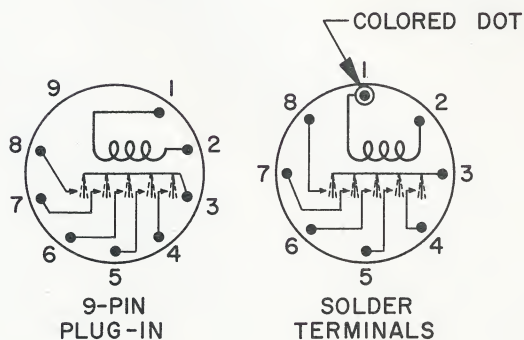
Coil Resistance: 530 ohms dc $\pm 10\%$

Coil Impedance: Approx. 3000 ohms
at 400 CPS

Sensitivity: 1.0 VRMS maximum
2.0 VRMS minimum

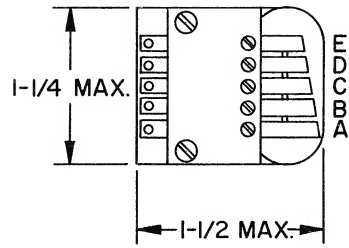
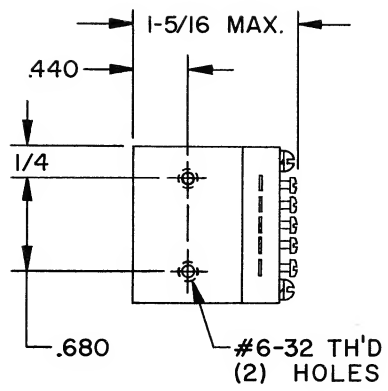
Contact Duty Cycle: 10% minimum at
resonant frequency, 6 VRMS

Contact Rating: 100 ma peak at 50 VDC
resistive load

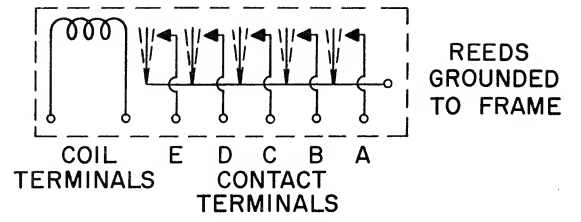


RD5S

MORE



RD5



BRAMCO CONTROLS DIVISION, LEDEX INC.
COLLEGE & SOUTH STREETS
PIQUA, OHIO

PRICES EFFECTIVE 4-1-65

STOCK ITEMS

REED COMPONENTS	RD1 RE1	RD10 RE10	RE2	5 REEDS RD5	RD5S	4 REEDS RD7C
QUANT (MAX)	1-10		1-4	1-4	1-4	1-4
PRICE	\$15.00		\$24.00	\$12.50	\$21.00	\$22.00
DELIVERY	2 Days		2 Days	2 Days	2 Days	2 Days

TONE MODULES	MD1C	ME1C	MD5C	MPS1C
QUANT (MAX)	1-10	1-10	1-4	1-4
PRICE	\$49.00	\$49.00	\$79.00	\$59.00
DELIVERY	4 Days	4 Days	2 Days	2 Days

MADE TO ORDER ITEMS

	NUMBER OF REEDS				
RD5 DECODER	1	2	3	4	5
1-9	\$12.50	\$13.50	\$15.00	\$16.50	\$19.00
10-24	8.15	9.00	10.00	11.00	12.50
25-99	7.25	8.05	8.95	9.85	11.25
100-499	5.50	6.00	6.80	7.60	8.50
500-999	4.60	5.00	5.65	6.30	7.15
1000-4999	3.95	4.45	5.00	5.55	6.30

	NUMBER OF REEDS				
RD5S DECODER	1	2	3	4	5
1-9	\$21.50	\$22.75	\$24.50	\$26.25	\$28.50
10-24	15.65	16.75	18.00	19.25	21.00
25-99	13.90	14.90	16.00	17.10	18.75
100-499	10.60	11.20	12.30	13.20	14.20
500-999	9.15	9.60	10.30	11.00	11.90
1000-4999	7.95	8.50	9.10	9.70	10.50

	NUMBER OF REEDS				
RD7C DECODER	1	2	3	4	5
1-9	\$22.00	\$24.00	\$27.00	\$30.00	N/A
10-24	16.30	18.00	20.00	22.00	
25-99	14.50	16.10	17.90	19.70	
100-499	11.00	12.00	13.60	15.20	
500-999	9.20	10.00	11.30	12.60	
1000-4999	7.90	8.90	10.00	11.10	

MORE ►

MADE-TO-ORDER ITEMS

MODEL	RE1	RE10	RD1	RD10	RE2
1-9		\$20.00		\$20.00	\$26.50
10-24		15.00		15.00	24.00
25-99		12.50		12.50	21.50
100-499		10.50		11.00	17.50
500-999		8.75		9.50	14.85
1000-4999		7.75		8.50	14.00

TONE SIGNALING MODULES

MODEL	ME1C	MD1C	MPS1C	MD5C
1-9	\$49.00	\$49.00	\$59.00	See
10-24	44.00	44.00	54.00	Below
25-99	39.00	39.00	49.00	
100-499	36.00	36.00	44.00	

MD5C DECODER	1	2	3	4	5
1-9	N/A	\$69.00	\$72.25	\$75.50	\$79.00
10-24		61.50	63.50	66.00	69.00
25-99		57.50	59.50	61.50	64.00
100-499		54.00	55.50	57.00	59.00

All prices based on standard coils, frequency ranges, and tolerances. Any special frequency within the recommended ranges can be ordered at no extra charge. For units with frequencies outside the recommended ranges, or with special coils, or tuning tolerances, write factory for quotation.

Different frequencies and frequency groups can be combined to obtain the maximum quantity price per model.

Blanket orders for annual requirements with periodic releases can be arranged. Write factory for details.

Terms are net 30 days, F.O.B., Piqua, Ohio. Delivery on made-to-order units is 6 weeks ARO.



BRAMCO CONTROLS DIVISION, LEDEX INC.
College and South Streets, Piqua, Ohio 45356 • Phone 513-773-8271

NAME _____ TITLE _____ DATE _____
COMPANY _____
ADDRESS _____
CITY & STATE _____

REPLY CARD

- ☐ HAVE REPRESENTATIVE CALL: MY PHONE NUMBER IS _____
☐ SEND SPECIFIC INFORMATION ON A DESIGN
THAT MEETS THE REQUIREMENTS LISTED BELOW.

APPLICATION: _____

QUOTATION QUANTITIES: _____

NUMBER OF CHANNELS PER RELAY: _____ Fold  Here

FREQUENCIES: _____ TOL. $\pm$ _____ %

BANDWIDTH:

MINIMUM $\pm$ _____ % AT _____ VRMS

MAXIMUM $\pm$ _____ % AT _____ VRMS

SENSITIVITY:

MINIMUM _____ VRMS MAXIMUM _____ VRMS

COIL: _____ OHMS DC RESISTANCE

- PACKAGE: ☐ OPEN FRAME ☐ COVERED
☐ SEALED ☐ SHOCK MOUNTED
☐ MODULE, INCLUDING ASSOCIATED CIRCUITRY

ADDITIONAL REQUIREMENTS _____

STAPLE HERE

PERMIT NO.

230

FIRST CLASS

PIQUA, OHIO

BUSINESS REPLY MAIL

NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY—

BRAMCO CONTROLS DIVISION
LEDEX INC.
P. O. BOX 207
PIQUA, OHIO 45356



DESIGN- ENGINEERING AIDS

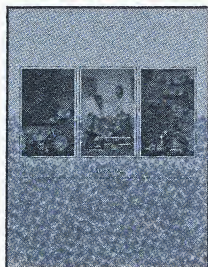
The three divisions of Ledex specialize in remote control components and packaged control solutions.

Ledex Inc., the parent company, designs and manufactures electronic and electro-mechanical components . . . remote control switching and actuating systems.

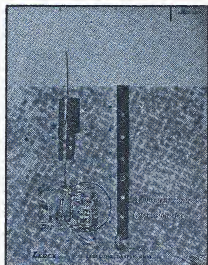
Bramco Controls Division designs and manufactures frequency sensitive resonant reeds that encode and decode audio signals for remote control systems.

Wilmington Controls Division designs and manufactures manual rotary switches.

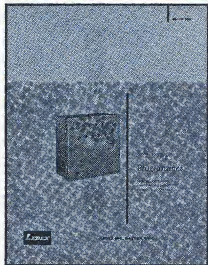
This is Ledex. Three coordinated divisions with experienced, creative engineers. They make up the development and production teams which consistently come up with big solutions in small packages. This brochure presents the technical literature available from each division.



"Resources and Skills." The best way to see how we solve control problems is to visit us. The next best way is for our plant to visit you . . . with this brochure.



"Armament Controls/Intervalometers" shows typical Ledex products in this special military field. An increasingly important Ledex activity is the design and development of packaged control systems, solid state and electro-mechanical.



"Programmers" simplifies complex sequential control and timing of series of related events. Applications include automatic machine tool control, heater and air conditioning, sequential, warning and signal controls.



LEDEX INC., 123 WEBSTER STREET, DAYTON, OHIO 45402
Designers & Manufacturers Electronic & Electro-Mechanical Components
& Remote Control Switching Systems phone (513) 224-9891

Permit No. 1069
FIRST CLASS
Dayton, Ohio

BUSINESS REPLY MAIL

NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY

LEDEX INC.
123 WEBSTER STREET
DAYTON, OHIO 45402

*Use handy return
cards to order
literature.*

**Please send literature
on the following:**

☐ "Resources and Skills"

☐ "Armament Controls/
Intervalometers"

☐ "Programmers"

☐ "Rotary Solenoids"

☐ "Push/Pull Solenoids"

☐ "Stepping Switches & Circuit
Selectors"

☐ "Long Life Stepping Switch"

☐ "Step Servo Motors"

☐ "Ledex Rectifiers, Arc Suppressors
and Pulsers"

Comments/Questions _____

Name _____

Title _____ Firm _____

Address _____

City _____ State _____ Code _____

**Use handy return
cards to order
literature.**

Rotary Solenoids

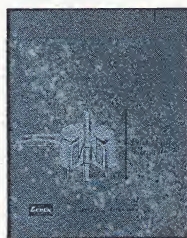


Ledex rotary solenoids are used to step, turn, pull, there's a need for fast, remote rotary action. One of camera shutter in Mariner IV, taking the historic first Known best for their compactness and high torque-to-size ratio, 8 basic sizes with strokes from 20° to 95°, torque to 98 lb-in. 200 stock models.

Endurance engineered rotary solenoids have life of million cycles when Ledex lubricant is applied at intervals, 50 million without relubrication.

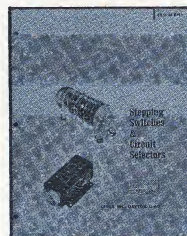
Ledex solenoid applications include valves, tape recorders, sorting equipment, gyro-caging, computers, vending machines, guidance controls, ground support transportation and material handling vehicles.

Push/Pull Solenoids



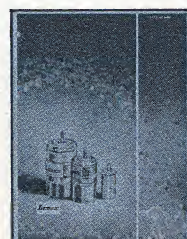
Ledex precision push/pull solenoids are designed for fast response and high force to size, and are engineered to respond in 10 milliseconds at intermittent duty. They are available in flat-face plungers. A comparison of the two designs (table 1) states the performance of a size 3 solenoid at 90 watt. This catalog lists stock models for quick starts on prototype data, force and stroke curves, and graphs showing hold time and resistance factors.

Stepping Switches & Circuit Selectors



Our catalog shows how the Ledex rotary switch works and provides useful information on control circuits, load circuits, stock models, along with schematics and new guides to solving switching problems.

Step Servo Motors



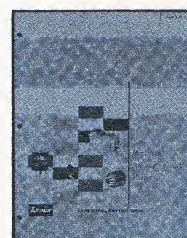
The Ledex step servo motors catalog contains a useful information field, as well as an outline of types of step servos, features, stock and custom models, applications, and ordering information given includes the following:

When the step servo coil is energized, the armature engages the clutch, and transmits the rotary motion of the output shaft, causing the shaft to rotate one step.

Release of power permits a spring to return the solenoid to starting, or de-energized, position. Spring loaded ball detent and load in the advanced position. Subsequent pulses of current cause this action to be repeated, each pulse advancing the output shaft one step.

Bi-directional models use the same principle with two detents having a common detent and output shaft.

Rectifiers, Arc Suppressors and Pulsers



Ledex silicon bridge rectifiers have built-in protection from the AC or DC line. Ledex arc suppressors take the place of arc suppression. Ledex solid state square wave pulsers provide pulse rates from a continuous power source and provide timed pulses.

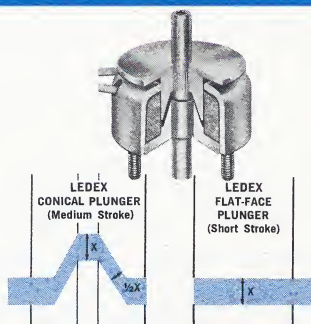
You can get a single package from Ledex that does all the following: rectify AC voltage, suppress arc and provide timed pulses.

trigger—wherever
they clicked the
photos of Mars.
size, they come in
ound-inches. Over

over one hundred
als of ten million

orders, waveguide
wireless teletypes,
equipment, trans-

extremely rapid re-
spond in less than
e with conical or
(opposite) demon-
s and 1/10 duty.
be work, technical
in resistor values



Conical-face plunger provides more output force for strokes from .030 to .250 inches.

Flat-face plunger gives fast response and high force for strokes to about .030 inches.

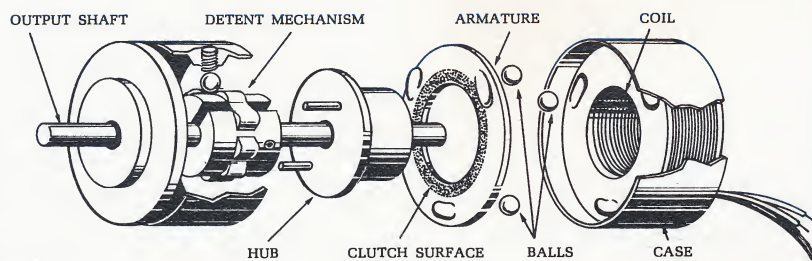


Size 3 Solenoid	Force with Ledex flat-face plunger, 90 watts, 1/10 duty.	Force with Ledex conical plunger, 90 watts, 1/10 duty.
.020 inch stroke	27 pounds	16 pounds
.060 inch stroke	10 pounds	13 pounds

For short strokes, the flat-face model really packs a wallop. The conical-face gives more mid-range punch.

Long Life Stepping Switch.

Of particular interest is the Ledex long life stepping switch that makes/break 5 amps... with a life of 50 million steps without maintenance or adjustment. It was designed to (1) switch complex high power circuits, (2) eliminate auxiliary relays, (3) deliver long term reliability, and (4) require no maintenance or adjustment. It has form C contacts and exceptional control versatility. Any of the standard Ledex control principles for sequence stepping or automatic control can be used.



roduction to this
s and advantages,
ecifications. Basic

ub moves axially,
e armature to the

noid armature to
nts hold the shaft
put voltage cause
shaft one further

o opposing arma-

S

against transients
guesswork out of
provide pre-deter-
erve as rectifiers.
or any combina-
s, clip transients,

Permit No. 230
FIRST CLASS
Piqua, Ohio

BUSINESS REPLY MAIL

NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY

**BRAMCO CONTROLS DIVISION
LEDEX INC.
P.O. BOX 207
PIQUA, OHIO 45356**

Permit No. 152
FIRST CLASS
Wilmington, Ohio

BUSINESS REPLY MAIL

NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY

**WILMINGTON CONTROLS DIVISION
LEDEX INC.
360 SOUTH NELSON ROAD
WILMINGTON, OHIO 45177**

BRAMCO CONTROLS DIVISION

Please send the following literature:

- ☐ "Control Techniques with Resonant Reed Relays" catalog.
- ☐ "Remote Controls" folder.
- ☐ Specific information that will help me with the following application:

Name

Title

Firm

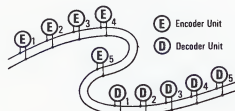
Address

City

 State

 Code

Audio Tone Decoding



A single pair of wires, or a leased telephone line, can carry the audio signals for a complete control system.



For inaccessible areas or mobile installations, a radio transmitter and receiver system can carry the signals.



Control Techniques with Resonant Reed Relays

This manual discusses fundamental resonant reed theories, definitions, and basic applications, and illustrates schematics and block diagrams. If you work with controls that select, command, regulate, supervise or indicate, you should know about how it can be done with audio signals. This book shows you how.



Remote Controls

Here is a folder containing product sheets of Bramco encoders and decoders, components & systems, price information, and data sheets giving resonant reed relay specification definitions.

BRAMCO CONTROLS DIVISION, LEDEX INC.
College and South Streets, Piqua, Ohio 45356 • phone (513) 773-8271

WILMINGTON CONTROLS DIVISION

Please send me the following literature:

- ☐ Manual Rotary Switch Catalog.
- ☐ Rotary Switch Specification Sheets.
- ☐ Specific information that will help me with the following application:

Name

Title

Firm

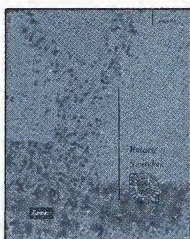
Address

City

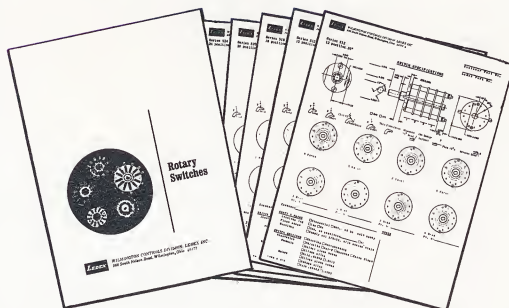
 State

 Code

Manual Rotary Switches



This catalog is prepared for the engineer or buyer who works with manual rotary switches, and for the man who specifies solenoid driven switches. In addition to details of the new rotary switch line, the catalog includes engineering considerations for contacts, rotor blades, finishes, materials and insulation, plus electrical and mechanical design guides.



Specification sheets for each switch series are available. They simplify the job of outlining your requirements. Each sheet contains standard dimensions, symbols, circuit layout, and available optional materials.

WILMINGTON CONTROLS DIVISION, LEDEX INC.
360 South Nelson Road, Wilmington, Ohio 45177 • phone (513) 382-3767